CLAIMS

1. A digital modulation apparatus for converting input source data to an NRZI format modulated code having a limited run length, comprising:

5   modulated code generating means of generating a plurality of candidate modulated codes with respect to the source data, the plurality of candidate modulated codes being candidates for the modulated code;

DSV change calculating means of calculating a degree of a change in a DSV of a modulated code sequence when each of the plurality of candidate modulated codes generated by the code generating means is selected as the modulated code;

modulated code determining means of comparing the degrees of changes in the DSVs calculated by the DSV change calculating means with each other, and determining that one of the plurality of candidate modulated codes generated by the modulated code generating means, the one causing the degree of a change in the DSV to be relatively small, should be used as the modulated code; and

modulated code selecting means of selecting one of the plurality of candidate modulated codes generated by the code generating means, the one corresponding to a result of determination by the code determining means, and outputting the selected candidate modulated code as the modulated code.

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2. The apparatus of claim 1, wherein

the degree of a change in the DSV is calculated within a range corresponding to a code sequence including a predetermined number of nearest candidate modulated codes generated by the modulated code generating means, and

25   the predetermined number is determined, depending on characteristics of a signal reproducing apparatus for reproducing the modulated code.

3. The apparatus of claim 1, wherein

the degree of a change in the DSV is calculated within a range corresponding to a code sequence including a predetermined number of nearest candidate modulated codes generated by the modulated code generating means, and

the predetermined number is determined, depending on characteristics of a low-pass filter circuit for determining a binary slice level in a signal reproducing apparatus for reproducing the modulated code.

4. The apparatus of claim 1, wherein

the DSV change calculating means includes:

CDS holding means of holding a CDS corresponding to a DSV of each code in a code sequence including a predetermined number of candidate modulated codes generated by the modulated code generating means; and

CDS accumulating means of accumulating the CDS of each code in the code sequence and holding the accumulated value,

wherein the DSV change calculating means outputs the CDS accumulated value held in the CDS accumulating means as the degree of a change in the DSV.

5. The apparatus of claim 4, wherein

the CDS holding means, when a code is input to the DSV change calculating means, holds a first CDS of the input code and outputs a second CDS of an oldest code of the held CDSs, and

the CDS accumulating means adds the first CDS to and subtracts the second CDS from the CDS accumulated value held therein and holds the resultant value as a new CDS accumulated value.

6. The apparatus of claim 5, wherein

the CDS holding means is a shift register.

7. The apparatus of claim 1, comprising:

DSV calculating means of calculating a DSV of a modulated code sequence when each of the plurality of candidate modulated codes generated by the modulated code generating means is selected as the modulated code,

wherein the modulated code determining means, when all the degrees of changes in the DSVs exceed a predetermined threshold, performs the determination, and when at least one of the degrees of changes in the DSVs is smaller than or equal to the predetermined threshold, compares DSVs whose degree of a change is smaller than or equal to the predetermined threshold, among the DSVs calculated by the DSV calculating means, with each other, to determine that one of the plurality of candidate modulated codes generated by the modulated code generating means, the DSV of the one being closer to a predetermined value.

8. A digital modulation apparatus for converting input source data to an NRZI format modulated code having a limited run length, comprising:

modulated code generating means of generating a plurality of candidate modulated codes with respect to the source data, the plurality of candidate modulated codes being candidates for the modulated code;

DSV calculating means of calculating a DSV of a modulated code sequence when each of the plurality of candidate modulated codes generated by the modulated code generating means is selected as the modulated code;

DSV resetting means of initializing the DSV calculated by the DSV calculating means;

modulated code determining means of comparing the DSVs calculated by the DSV calculating means with each other, and determining that one of the plurality of candidate

modulated codes generated by the modulated code generating means, the one causing the DSV to be relatively small, should be used as the modulated code; and

modulated code selecting means of selecting one of the plurality of candidate modulated codes generated by the modulated code generating means, the one corresponding to a result of determination by the code determining means, and outputting the selected candidate modulated code as the modulated code.

9. The apparatus of claim 8, wherein

the DSV resetting means performs the initialization when any of the DSVs calculated by the DSV calculating means is larger than or equal to a predetermined threshold.

10. The apparatus of claim 9, wherein

the predetermined threshold is determined, depending on characteristics of a signal reproducing apparatus for reproducing the modulated code.

11. The apparatus of claim 9, wherein

the predetermined threshold is determined, depending on characteristics of a low-pass filter for determining a binary slice level in a signal reproducing apparatus for reproducing the modulated code.

12. The apparatus of claim 8, wherein

the DSV resetting means performs the initialization in predetermined cycles.

13. The apparatus of claim 12, wherein

the predetermined cycle is determined, depending on characteristics of a signal reproducing apparatus for reproducing the modulated code.

14. The apparatus of claim 12, wherein

the predetermined cycle is determined, depending on characteristics of a low-pass filter for determining a binary slice level in a signal reproducing apparatus for reproducing

5   the modulated code.

15. A digital modulation apparatus for converting input source data to an NRZI format modulated code having a limited run length, wherein

a value corresponding to a logic level of each bit in a sequence of the modulated

10   code is weighted, depending on a run length, and is accumulated, the resultant value is used as a measure indicating a DC component included in the sequence of the modulated code, and the modulated code is selected so that the measure approaches a predetermined value.

15   16. The apparatus of claim 15, wherein

the weighting depending on the run length is performed so that, when a first run length is larger than a second run length, a weight corresponding to the first run length is larger than or equal to a weight corresponding to the second run length.

20   17. The apparatus of claim 16, wherein

the weights corresponding to the first and second run lengths are determined based on accumulated values corresponding to the first and second run lengths in an analog signal waveform corresponding to the sequence of the modulated code.

25   18. A digital modulation method for converting input source data to an NRZI format modulated code having a limited run length, comprising:

a modulated code generating step of generating a plurality of candidate modulated

codes with respect to the source data, the plurality of candidate modulated codes being candidates for the modulated code;

a DSV change calculating step of calculating a degree of a change in a DSV of a modulated code sequence when each of the plurality of candidate modulated codes

5   generated by the code generating step is selected as the modulated code; and

a modulated code outputting step of comparing the degrees of changes in the DSVs calculated by the DSV change calculating step with each other, and outputting, as the modulated code, one of the plurality of candidate modulated codes generated by the modulated code generating step, the one causing the degree of a change in the DSV to be

10   relatively small.

19. The method of claim 18, comprising:

a DSV calculating step of calculating a DSV of a modulated code sequence when each of the plurality of candidate modulated codes generated by the modulated code

15   generating step is selected as the modulated code,

wherein the modulated code outputting step, when all the degrees of changes in the DSVs exceed a predetermined threshold, performs the outputting, and when at least one of the degrees of changes in the DSVs is smaller than or equal to the predetermined threshold, compares DSVs whose degree of a change is smaller than or equal to the predetermined

20   threshold, among the DSVs calculated by the DSV calculating step, with each other, to determine that one of the plurality of candidate modulated codes generated by the modulated code generating step, the DSV of the one being closer to a predetermined value.

20. A digital modulation method for converting input source data to an NRZI format

25   modulated code having a limited run length, comprising:

a modulated code generating step of generating a plurality of candidate modulated codes with respect to the source data, the plurality of candidate modulated codes being

candidates for the modulated code;

a DSV calculating step of calculating a DSV of a modulated code sequence when each of the plurality of candidate modulated codes generated by the code generating step is selected as the modulated code;

5   a DSV resetting step of initializing the DSV calculated by the DSV calculating step; and

a code outputting step of comparing the DSVs calculated by the DSV calculating step with each other, and outputting, as the modulated code, one of the plurality of candidate modulated codes generated by the modulated code generating step, the one

10   causing the DSV to be relatively small.

21. A digital modulation method for converting input source data to an NRZI format modulated code having a limited run length, wherein

a value corresponding to a logic level of each bit in a sequence of the modulated

15   code is weighted, depending on a run length, and is accumulated, the resultant value is used as a measure indicating a DC component included in the sequence of the modulated code, and the modulated code is selected so that the measure approaches a predetermined value.